

THE WHOLE ART *N. 300*
OF REFLEX DIALLING,

Shewving the vway to make all

manner of Dials which shall shew the houre
by a spot of light reflected from a Glasse
upon any Cieling whether it be flat
or curved, or any other
way irregular.

~~532 d. 23.~~
~~3~~

A S A L S O

Vpon any other object whatsoever,
and whether the Glasse be plain, or
convex, as likewise whether it lie in the plain
of the Horizon, or oblique unto it.

*Together with all necessary furniture
belonging thereunto.*

All performed by an easie Instrument fitted,
with lines to that purpose.

Published by ANTHONY THOMPSON.

L O N D O N,

Printed, For *William Leybourn* M. DC. LVIII.



16

156

N. 556

Jenner

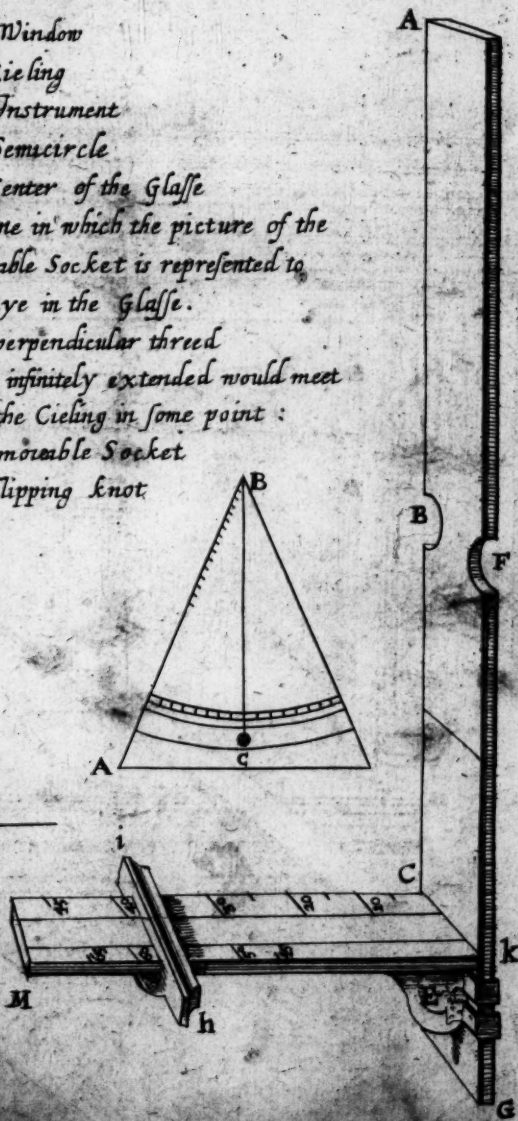
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his Books And Tools
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John: Jenner
Jenner





- M.N . the Window
 O . the Cieling
 C.D . the Instrument
 A.B . the Semicircle
 H . the Center of the Glasse
 H.I . the line in which the picture of the
 moveable Socket is represented to
 the eye in the Glasse.
 K.L . the perpendicular threed
 H.I . being infinitely extended would meet
 with the Cieling in some point :
 F.G . the moveable Socket
 I . the Slipping knot



The figure of the Instrument

516 d.
3

R. Blackburne. 73.

O

K

I

G

D

E

H

B

A

M



532. d. 26.

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L O N D O N,

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THE WHOSE ART M.
OF REFLEX DIAMING

Showing the way to make all
the most difficult and
by a good and simple
method of teaching which has
been tried, and found to be
correct, and useful.

And where the object is to
show the child the plain
of the letters, and the
of the letters, and the
of the letters, and the



together with all necessary
belonging to the same

All performed by an artist
with the most perfect

Printed by ANTHONY THOMPSON.

L O N D O N

Printed by Thomas M. D. C. L. VIII.

The Publisher to the Reader.

Courteous Reader,



These short precepts of reflected Dialling, the late invention of a Friend of mine, I have thought fit to let the World see, and together with them, have annexed some precepts of the same Nature, formerly written by their Author Mr. Sam. Foster, sometime Astronomy Professor, in Gresham Colledge; to whom the world is indebted for much variety in all kind of Dialling, and the first I know that in England made these sort of Reflected Dials to oblique Glasses, in so much that although this now published be wholly new, & without any dependance upon any thing ever done by him, yet the Author will not be ashamed to acknowledge that the difficulties that he found arise in the practice of some wayes of that Author, put him upon this as he thinks more easie then any yet published.

A 2

Farevvell.



CHAP. I,

The Description of the Instrument.

LET there be a streight Ruler of Wood, or Brasse made A G, the length, breadth and thicknesse, at discretion: about the middle of it, or neerer to the end A, let the hollow B be made large enough to encompassse a socket of Brasse, into which the Glasse must be fitted, and so that the fiducial edge A B C may be imagined to passe through the Center of the Glasse, when it is fixed. On the other side, as at F, may be made another hollow, like that at B, to the end you may use either edge of the Ruler, as occasion may serve, to the end of this Ruler must be added another at right angles C M, made moveable, yet so supported by a bracket E, behind, that it may stand steady at right angles, and unto this let there be fitted a slipping socket with a fiducial edge *h*, let the piece C M be divided as a tangent line to the Radius B C, and of that length that it may contain about 47, or 48 degrees, which you need not divide beyond 45, on the other side K M, to a shorter Radius, let the tangent line be continued to 64 deg. or thereabout, which will be farre enough for most Dials of this kind, the whole representing two sides of a Rectangular Parallelogram, or Carpenters square, the one legge longer than the other, all which by the figure annexed, is easily understood.

CHAP.

CHAP. 2.

Precepts for the ready Use of this Instrument.

First, in the place where you intend the Glasse shall lye, make fast some piece of Wood or Brasse, exactly Horizontal, unto which you may joyn some other large piece of Board, Pastboard, or other, it matters not, so as it be made to stand firm, and Horizontal, till the Dial shall be finished, and then taken away.

Secondly, Having upon any part of your fixed piece of Wood made a mark, over which precisely shall be the Center of your Glasse, and upon this mark as a Center describe so much of a Circle as is necessary, to as large a Radius as the Pastboard will give way, and then the Sun shining hold up a threed, so that the shadow of it may passe through the Center of your Circle, and mark where it cuts the Circumference, and at the same instant take his altitude, and find his azimuth either trigonometrically, or by some Astrolabe: (of all projections of the Sphear I know none so exact for the performance of all things necessary for the making these Dials, as the solution of all other Astronomical Problemes, as that commonly called *Blagayes Jewel*, now put out, every way much amended, and altered by Mr. *John Palmer*, Rector of *Eton* in *Northampton Shire* my especial friend.)

Thirdly, Having found his azimuth, set off now the South or East line, by help of a Scale of Chords made to the Radius of your formerly described Circle, we will take the Example of an East Dial; As for Example, in the latitude of 52 deg. 15 min. I observed in the Tropick of *Cancer* the Suns altitude 15 deg. 00 min. by my Astrolabe I find his azimuth; then from the East, or six of clock line was 19 deg. or 71 deg. from the Meridian or Midnight line Northward, but because in this Example the Meridi-

an

an could not be expressed, I set off 19 degrees upon ~~my~~ Circle to the right Coast, and there through the Center draw a line which shall represent the East azimuth.

Fourthly, Your East or Meridian line, if it may be, being thus drawn, have recourse to your Astrolabe, or by Trigonometry find these ensuing things. First, for all necessary houres which will come upon the Dial, find the Suns azimuth, and likewise what altitude it hath in that hour, and Azimuth, do this for the Tropick, and the Horizon (in Dials made to Oblique Glasses) the Equinoctial, or for as many of the Suns Parallels as you please, I have made choice of the distance upon the Horizon, and Tropick of *Cancer*, for in a flat roof two are enough, because the hours will be streight lines, otherwise if the roof be concave, convex, or any way un-even, it will require the finding of more points, write these down, as in the Table ensuing.

In the Latitude of 52 degrees, 15 minutes.

*Distances from the East
on the Horizon.*

In the Tropick of Cancer.

<i>Hours</i>	<i>deg.</i>	<i>min.</i>		<i>Hon. Azim. from East.</i>			<i>☉ Abis.</i>
				<i>H m.</i>	<i>D. m.</i>	<i>D. m.</i>	
4	36	00	} <i>From East Northward.</i>	4 00	37 30	02 00	
5	18	40		5 00	25 40	10 00	
6	00	00		6 00	15 00	18 30	
7	18	40	} <i>From the East South- ward.</i>	7 00	03 30	27 30	
8	36	20		8 10	09 00	37 00	
9	51	40		9 00	22 30	45 30	
10	65	30		10 00	40 00	53 30	
11	78	20		11 00	62 30	59 30	
12	90	00					

CHAP.

CHAP. 3.

HAVING gone thus farre, your next work will be to fasten your Glasse in its socket, to what obliquity you please, at adventure, and so to order all things that the Center of your Glasse may be directly over the Center of your formerly described Circle; and the height of the Center of your Glasse equal to the thickness of your Instrument; so that the hollow part of the Ruler encompassing the socket, the fiducial edge may passe through the Center of your Glasse, which you may marke with a little speck of ink, till your Dial is done.

The hours are to be drawn in this manner; First, limit the Horizon, if your Glasse lye oblique to it, to the end the line be not extended where the Sun can never shine; This work is easily done if the roof be flat, by finding only two points thus;

Place your Instrument as before, and slip the moveable socket, to 0 deg. 0 min. then hang up a perpendicular threed in any part of the roof, that it may fall upon the Horizon, then putting your Instrument gently to the threed, observe with your eye where the fiducial edge of the socket is reflected through the Center of your Glasse, and there make a mark by a slipping knot, or any other way you please, then holding a thread upon the Center of your Glasse, gently extend it by the former mark, till it come to the Ceiling, and there make a mark, for that shall be one point of your Horizon reflected, repeat this work as oft as you please, so shall you have as many points as you desire, through which draw a line that makes no angles, which shall be the reflected Horizon.

Go now to your Table of distances from the East and first set off the six of Clock line, in this manner; Extend a threed infinitely, that may passe through the Center of your Glasse, and the six of Clock mark in your Horizontal Circle, then in the reflected Horizon, hold up a perpendicular thread with a plummet at the end, that may just touch your other threed, and in the reflected Hori-

zon make a mark. Do thus for all the other distances according to your Table, and make several marks.

Then lastly, go to your Table for the Tropick of Cancer, and in the mark in your Circle belonging to every hour, place your Instrument; and move the socket in the upright ruler to the degree of Altitude belonging to that hour, and marked in the Table, and with your eye project it by a thread hung up any where with a slipping knot in the same manner you did your reflected Horizon; and where a thread extended from the Center of the Glasse touching the Ceiling that is the point for that hour, and a line drawn from the point to its correspondent in the Horizon shall represent the line where the reflected spot of light will be for all the year. Do this for all the rest.

CHAP. 4.

IN this manner may the furniture of Dials be easily put on, viz. the Parallels of Declination, of Altitude, of Azimuth, points of the Compasse, proportions of the shadowes to the Gnomons, and the like, which every mans industry will easily perform.

CHAP. 5.

*How to performe all the fore-going precepts,
without any projection by the eye.*

FOrasmuch as the finding the reflection of the socket *h i*, through the Center of the Glasse; and after that the projection of the necessary points may seem difficult to some not used thereunto, though in it self it be easie; I have added this Chapter, whereby the help of an instrument *A B*, Let the perpendicular ruler of your projecting Instrument *C M* be placed within the room, and applied to that Azimuth to which you desire to project the correspondent hour, and then by help of your

*may be
informe*

your plummet B C observe what inclination your Glasse hath to the Horizon in that Azimuth, double that, and adde it to your tabular Altitude, and to that degree remove your sight, then a threed drawn thereby from the Center of the Glasse shall give you the point desired in the roof. *Example*, In the latitude of 52. 15 in the Tropick of *Cancer*, I find the Suns Azimuth 15 deg. and the Altitude in our Horizon 18 d. 30'. But by a plumbline B C, I find the Glasse in that Azimuth to incline to the Horizon 5 d. 00', I say it to 18 d. 30', the Altitude in our Horizon, I adde 10 d. 00', the double of the inclination of the Glasse, and to the Altitude, viz. 28 d. 30', I remove the sight h D i, and from the Center of the Glasse, through the point D, I draw a threed that shall shew the point upon the roof. But because the Diameter of the Glasse is commonly little, and consequently the inclination, not accurately to be taken, you must either continue the plain of your Glasse, or work by this proportion.

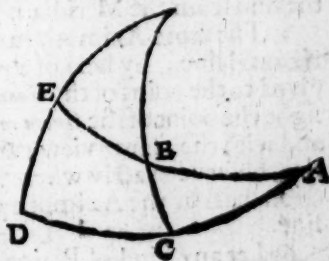
As the Radius, is to the tangent of the greatest Inclination: So is the Cosine of the Ark comprehended between that and the Azimuth in which you seek the Inclination, to the tangent of the Inclination sought.

~~Let~~ ED the greatest inclination.

DC the Ark comprehended between the two Azimuths.

BC the inclination sought.

A the common intersection of the Horizon of the plain, and of the place, the proportion is plain, as AD Radius is to DE tangent: So is AC, the Cosine of DC, to BC a tangent. But here it is necessary that the Glasse be first fixed at a given angle,



F I N I S.

A general and most easie way, to project houre

lines on all kinds of superficies without any knowledge

how they are situated in respect of Declination

or Inclination.

I.

Let the *Gnomon* being first sharpened with a point be shaped, and fastned in such manner that it may no ways hinder, either the Draught of the *Horizontal* line, or the point of the shadow from having free accessse to the Dial at all times of the yeare.

2 Draw a *Horizontal* line by help of the Semicircle in a true leuell both in regard of it self, & also to the point of the *Gnomon*, through the whole superficies, on which the Dial is to be described, and if the superficies be very much inclined to the Horizon, so that it will not receive the horizontal line upon it, you must set up some board or such like, upon which for a time you are to inscribe the *Horizontal* line, and by help of which the houre lines are to be projected upon the superficies.

3 Observe the point of the shadow of the *Gnomon*, and the Suns Altitude at the same instant of time.

4 By the Altitude observed, compute the Azimuth of the Sun from the Meridia.

5 The same Azimuth must be projected upon the *Horizontal* line, by help of a perpendicular threed either applied to the point of the *Gnomon*, or else covering to your sight the point of the *Gnomon* and shadow both together; and with the same view cutting thorough the *Horizontal* line, observe exactly where it then cuts, for that same section shall be the Azimuth projected upon the *Horizontal* line.

6 Let any kind of Plaine board, or Past-board be now applied to the *Horizontal* line, which must also touch the point of the *Gnomon*, and consequently shall therefore exactly agree with the Plane of the Horizon, upon which Plane the point of the *Gnomon* is to be signed, which may be called the Center, and afterwards a right line is to be drawne

drawne also upon the same Plane from the Center to the signe of the Azimuth, which was before marked upon the Horizontal line.

7 Then taking the same Plaine board or past-board away, describe upon it the Meridian line or the houre of 12, draw it from the Center before noted at the true angle that it hath from the Azimuth before drawne, and also to the true Coast of the World, and let it be extended on both sides the Center if need be.

8 To the Meridian so pitched let the lines of an Horizontal Dial (for the Latitude wherein you are) be drawne thereto out of the Center upon the Plaine.

9 Then again, let the Plaine be applyed to its former situation, so as that the Center of the Horizontal Dial upon the Plaine, may agree to the point of the *Gnomon*, and the Azimuth also, which was drawn upon the Plain may fit with the azimuth before projected upon the horizontal line, which done, let a threed be fixed in the center of your horizontal Dial upon the Plaine, by helpe where of you may transfer every houre from the Plaine into the Horizontal line, and let every houre be there noted with a several point, especially take notice of the houre of 12, which if it chance to runne off your superficies, you must (till your Dial be finished) fasten some kind of object (whereon the Horizontal line is also to be projected) that may receive it.

10 After all this, take your Plaine away (for there will now be no more need of it) and conjecture where about the Axis of the world would passe from the point of the *Gnomon*, to the Poles of the world, for in that place is the Meridian to be projected, which that it may be done more commodiously you must place some object in the way that may receive the same Meridian, unlesse perhaps the superficies of the Dial will supply that want, which very often it doth, now it matters not whether that object be placed below or above the *Gnomon*, you may do that which you find most convenient, only so that it stand in the way where the Axis must passe, upon the said Object you are then

then to project the Meridian line which will be done by helpe of a perpendicular thread, cast by your eye upon the point of the *Gnomon*, and also upon the point of 12 in the Horizontal line, both together; for so the perpendicular thread projected upon the Object shall shew where the Meridian is to be drawne.

11 Into this Meridian therefore one of the Poles of the world (which of them you find to lye most expedient) is to be inserted, by helpe of your Semicircle elevated or depreessed from the point of the *Gnomon*, towards the projected Meridian line, according to the Latitude of your place, so shall a thread extended from the Pole point thus signed out, unto the point of the *Gnomon*, represent the Axis of the World.

12 Last of all, by these you may easily project all the houres, for if by your eye you repose the thread or Axis upon each point of such houres as were before inserted into the horizontal line, every one of these projections shall represent upon any superficies that stands in your way, each of the houres required, now to draw the heure lines thus represented by the thread is an easie thing for every one to doe, among which hour lines the shadow of the point of the *Gnomon* as it creepeth along, will shew the time of the day.



FINIS.

